Title: **"**You can go your own way": Longitudinal analysis of school-level growth trajectories in the context of curricular choice

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Background and Context:

While greater autonomy of decision making at the school level has long been advocated as an approach for making schools more (Chubb & Moe, 1989), it is also seen as facilitating educational innovation (Kahlenberg & Potter, 2014).

However, allowing variation in decision making also allows for the possibility of greater variation in school effectiveness. In some cases, decentralizing decision making has increased variation in ways which exacerbate preexisting inequalities (Bryk et al., 2010). In addition, absent the development of systematic processes to identify effective sites and then identify and transfer effective and innovative educational practices, the benefits of innovation will remain limited (Bryk et al., 2015; Cannata & Rutledge, 2017).

In cases where decision making is decentralized, it is therefore important to analyze not only the difference in outcomes between groups (i.e., mean differences), but also the size and nature of the variation in outcomes within these groups (i.e., differences in variance or standard deviation). One such case occurred in Denver Public Schools in the spring of 2015, when leaders in schools with grades 4 through 8 were given a decision to (A) opt-into a district-selected curriculum for English language arts or (B) decline this option and purchase or develop their own curriculum for these grades.

Research Questions:

- *Did students in schools which chose the district-selected English Language Arts curriculum have higher rates of growth on state tests, after controlling for student- and school-level variables?*
- *Did schools which declined to adopt the district-selected curriculum have greater divergence in growth trajectories than schools which opted into the district-selected curriculum?*

Program:

Most district schools (n=90) chose to adopt the English language arts curriculum identified and supported by the district, developed by Expeditionary Learning/Engage NY. Schools declining to opt into this curriculum (n=31) report using a variety of resources, including *Genre Study* (n=6), *Lucy Caulkins* (n=3), *Montessori* (n=3), and *teacher-developed curricula and resources* (n=4). An additional 38 charter schools in the district provide an additional point of comparison for this analysis, although specific information regarding the choice of English language arts curriculum for these sites is currently unavailable.

Research Design:

In order to model differences in score growth between schools, we employ a quasi-experimental approach, analyzing student data longitudinally using a hierarchical linear growth model (Snijders & Bosker, 2012), with statistical controls for demographic characteristics at both the student- and school-levels.

Data Collection and Analysis:

Data used for this analysis consists of 136,186 student test scores nested in 53,450 students over the course of 4 years. Test scores come from the English language arts section of the Colorado Measure of Academic Success (CMAS) assessment, the state's common end-of-year measure of students' progress.

In order to calculate the school-specific growth trajectories of student scores, net the influence of student demographics at the individual and school-level, student achievement is modeled with the following equation:

$$y_{tij} = (\beta_0 + \alpha_j + \gamma_i + \varepsilon_{it}) + (\beta'_0 + \alpha'_j + \gamma'_i)YEAR_t + \vec{\beta}_1\vec{x}_i + \vec{\beta}_2\vec{z}_{jt}$$

where y_{tij} is the end-of-year test score for student *i* in year *t* in school j. Test scores are standardized to the district population within grade and school year (following Gates Foundation, 2010; Kane et al., 2013). $\vec{x}_i$ is a vector of student-level characteristics of student *i*, including race/ethnicity, gender, free- or reduced price lunch status, special education status, grade cohort, and English learner status. $\vec{z}_{jt}$ is a vector of school-level characteristics including each of these demographic characteristics aggregated as a school-level percentage of total enrollment. The variable $YEAR_t$ is coded {0, 1, 2, 3} for data corresponding to the 2014-15, 2015-16, 2016-17, and 2017-18 school years, respectively (note: curricular implementation began in 2015-16). This model includes normally distributed random effects (α_j, γ_i, α'_j, γ'_i) to model deviations at the individual- and school-levels from the group-average intercept and slope (β_0, β'_0). We then recover the estimated school-level slopes ($\hat{\alpha}_j$) and use these as a dependent variable. We employ ordinary least squares regression to calculate the mean differences of the slopes for these three groups of schools (curriculum opt-in, decline, and charter schools). In order to compare differences in within-group variance of these slope estimates, we employ a F-test for the equality of standard deviations/variances (Brown & Forsythe, 1974)

Findings/Results: School Growth Rates: Group Means: The average one-year growth rate for opt-in schools was +0.017 standard deviations of student achievement measured annually ($p=0.001$) (Table 1). Using established methods for conversion (Hattie, 2008; Kane & Staiger, 2012), we estimate that students in opt-in schools gained an additional 9.7 days of instruction, compared the district-wide average. Charter schools tended to underperform the other groups, with an average slope of -0.033 standard deviations ($p<0.001$). The average growth rate for decline schools was indistinguishable from zero at conventional levels of significance

Findings/Results: School Growth Rates: Standard Deviations: No statically significant differences were observed in the standard deviation of school-level growth rates of student scores (i.e., estimated school slopes) between the three groups of schools (Table 2).

Conclusions:

While growth trajectories were on average negative for charter schools and positive for opt-in schools, it is important to note that initial scores in Year 0 were above average for charter school students (~+0.14 sd) and below average for student in opt-in schools(~ -0.05 sd) (see Figure 1). While a negative relationship between initial state and growth is likely to be observed due to regression to the mean (Berliner, 2014; Koedel & Betts, 2010), the fact that these patterns persist over four-years of data instead suggest a convergence of overall school effectiveness between these three groups of schools in the district.

Furthermore, it is interesting that, given the theory of school-level decision-making autonomy as a source of variation, the variance of slopes was remarkably similar. Nonetheless, the school with the largest consistent growth rate is in the curricular *decline* group (see Figure 2), suggesting the presence of innovative school-level practices and policies which may inform improvement efforts in other schools.

The limitations of this analysis are also important to keep in mind. We are currently unable to account for a number of systematic differences in curricular implementation or teaching quality. Furthermore, there may be a number of unobserved variables which confound the relationship between the decision to opt into the district curriculum and subsequent increases in student achievement.

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Tables & Figures

Table 1. Mean and standard deviation of 3 year growth slopes, net influence of student- and school-level demographics, by school group

Metric	School Group	n	Estimate	95 % CI		p-value
mean(slope)	Opt in	90	**0.017*** **	0.007	0.027	**0.001**
mean(slope)	Decline	31	-0.001	-0.022	0.020	0.915
mean(slope)	Charter	38	**-0.033*** **	-0.050	-0.016	**<0.001**
sd(slope)	Opt in	90	0.049	0.043	0.058	--
sd(slope)	Decline	31	0.058	0.046	0.077	--
sd(slope)	Charter	38	0.051	0.042	0.066	--

Table 2. Between group ratio of standard deviations of growth slopes, with statistical significance.

Groups compared	**ratio**	**ratio(%)**	**p-value**
sd(decline)/sd(opt-in)	0.0575/0.0494	116%	0.257
sd(charter)/sd(opt-in)	0.0513/0.0494	104%	0.757
sd(decline)/sd(charter)	0.0575/0.0513	112%	0.502

Figure 1. Average within-group trajectories of student scores, net influence of student and school level demographic characteristics.

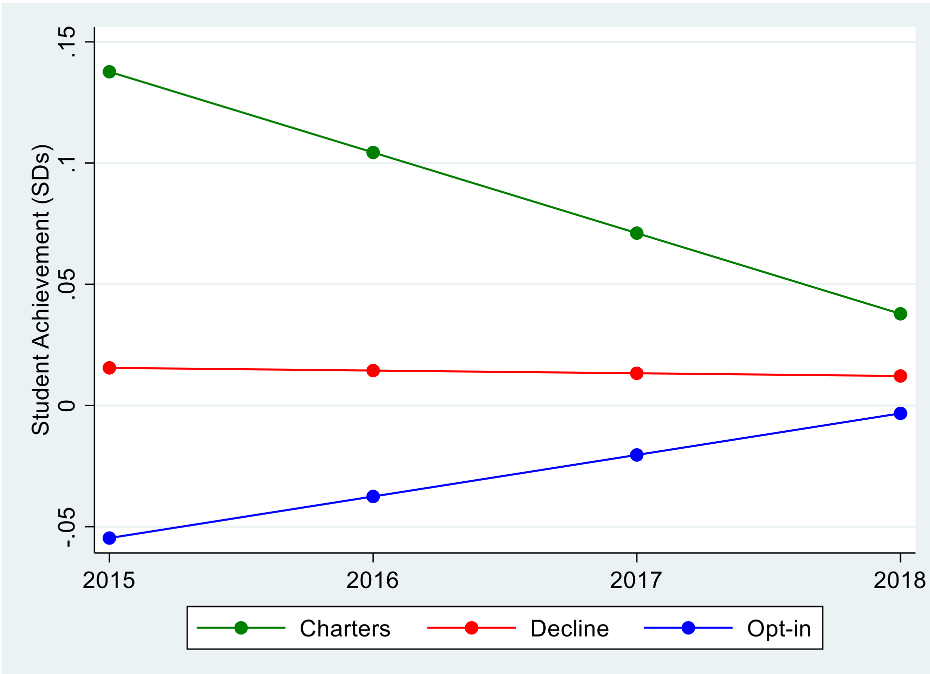

Figure 2. Plot of (binned) distribution of growth slope values, by group. These distributions reveal that the school with the larges growth slope value is found in the *decline* group of schools.